BULLETIN OF MARINE SCIENCE, 54(1): 71–93, 1994

ADDITIONS TO THE INVENTORY OF EASTERN TROPICAL ATLANTIC ASCIDIANS; ARRIVAL OF COSMOPOLITAN SPECIES

Claude Monniot and Françoise Monniot

ABSTRACT

An inventory of eastern tropical Atlantic ascidians is based on collections made using SCUBA and dredges during the 1990 cruise of the R/V SEA DIVER by Harbor Branch Oceanographic Institution. This account incorporates other samples previously taken in the same area. Two new species are described and the taxonomic status of 43 other species is reviewed; several of these species are extensively redescribed. The arrival of cosmopolitan species, absent from previous lists, is attributed to ship traffic.

The ascidians of the West African coast have been recorded by Michaelsen (1915), Sluiter (1927), Pérès (1948, 1949, 1951), Millar (1953, 1955, 1956, 1957, 1958, 1960, 1962, 1965), C. Monniot (1969), and F. Monniot (1969). There are relatively few species, compared to other tropical areas.

During the summer of 1990, one of us (F.M.) participated in a Harbor Branch Oceanographic Institution expedition from the R/V SEA DIVER to collect samples using dredges and SCUBA for biochemical studies. Samples were collected at depths of 0–60 m around the Azores, Canaries, and Cape Verde Islands, and along the coasts of Senegal and Sierra Leone. Other ascidians recently collected by K. D. Leung Tack off Dakar also have been studied, as well as some specimens already registered in the collections of the French Muséum National d'Histoire Naturelle.

Vouchers of 55 species have been examined, two of which are new. Twelve species already known from other parts of the world are recorded for the first time from the West African coast or from the Cape Verde Islands. These consist of: three Mediterranean species (*Ascidia involuta, Microcosmus claudicans,* and *Microcosmus savignyi*); one Caribbean species (*Didemnum cineraceum*); and eight cosmopolitan species (*Didemnum granulatum, Didemnum perlucidum, Didemnum psammathodes, Lissoclinum fragile, Polycarpa anguinea, Microcosmus exasperatus, Microcosmus helleri,* and *Herdmania momus*). Some of these eight cosmopolitan species are easily recognizable and were not found in the same region during collections made between 1900 and 1960.

Three species, the West African *Cystodytes guinensis,* the North American *Ascidia interrupta* and the western European *Clavelina lepadiformis* have now appeared in the Azores. These were discovered in a harbor and near the shore of Faial Island at stations where we had been diving in 1971 (C. Monniot, 1974; F. Monniot, 1974).

Ciona intestinalis in this area seems to live at the limits of its ecological tolerance. The species was abundant at Dakar in 1948 (Pérès, 1949). It seems to have disappeared from there now, but we have collected it for the first time in the Cape Verde Islands. It is more than likely that ship transport contributes significantly to the West African ascidian fauna by bringing in such species as the above ones.

Some other species that are already known to be widely distributed along the African coast may also have been introduced into many places there. These are *Clavelina oblonga* and *Ecteinascidia turbinata* (Dakar: Pérès, 1951), *Ascidia sydneiensis* (Sierra Leone: Millar, 1956), and *Cnemidocarpa irene* (Morocco: = *Styela*

(*Cnemidocarpa*) *maroccana* Sluiter, 1927). A South African species, *Pyura stolonifera,* has extended its distribution to Senegal and even reached the entrance of the Mediterranean Sea (Monniot and Bitar, 1983).

The west coast of Africa is much poorer in ascidian species than are other tropical shores. This relative poverty is probably linked to the large quantities of fresh water and the sediments carried into the sea there by major rivers. The marked turbidity of the sea along the West African coast does not favor filter-feeding organisms. There is also a large preponderance of muddy and sandy bottoms along this coast. These ecological conditions may also account for the absence of coral reefs in this area.

This new collection indicates that the general increase in ship traffic along this coast favored introduction of cosmopolitan ascidians, substantially modifying the structure of a relatively poor endemic ascidian fauna.

This faunistic survey has given us the opportunity to reexamine the systematic position of some species we have encountered in West Africa. In some cases (*Polycarpa anguinea, Polycarpa goreensis,* and *Microcosmus helleri*), several species have been placed in synonymy with the ones we report.

Clavelina oblonga Herdman, 1880

Material.—Azores: on littoral, Monte da Guia, Faial Island.

This species has been introduced into the Azores from North America. In 1971 it was limited to Horta Harbor in Faial Island.

Cystodytes dellechiajei (Della Valle, 1877)

Material.—Azores and Senegal.

This species is common to the whole tropical Atlantic Ocean and the Mediterranean Sea.

Cystodytes guinensis Michaelsen, 1914

Material.—Azores: Faial Island; Cape Verde Islands; Senegal.

This species is recorded for the first time in the Azores.

Cystodytes roseolus Hartmeyer, 1912

Material.—Senegal.

Described from South Africa, this species has been recorded several times in Senegal.

Cystodytes senegalense Monniot, 1969

Material.—Senegal.

The species has not been found outside the Dakar area.

Didemnum cineraceum (Sluiter, 1898)

Material.—Sierra Leone: Banana Island, 3 m depth.

The colony is encrusting, soft, 2 mm thick and 4 cm wide. The spicules are not abundant and are distributed among the zooids at the thoracic level. The common cloacal channels are wide.

The specimen collected in Sierra Leone corresponds well to the type specimen and to specimens described from the West Indies (F. Monniot, 1983). The species evidently occurs on shores throughout the tropical Atlantic Ocean.

Didemnum granulatum Tokioka, 1954

Material.—Senegal: Madeleine Island, 18 m depth.

This Pacific species is recorded in the Atlantic for the first time. All characters agree with the description given by Monniot and Monniot (1987).

Didemnum perlucidum Monniot, 1983

Material.—Senegal: Madeleine Island, on mussels and on the ascidian *Pyura stolonifera.*

The specimens are typical and contain larvae. *D. perlucidum* was described from Guadeloupe and has also been found in Polynesia and New Caledonia. This fouling species is especially common in harbors, on ship hulls and buoys. It has never been recorded along the African coast.

Didemnum psammathodes (Sluiter, 1895)

Material.—Sierra Leone: mouth of Sierra Leone River, and Banana Island.

This species is very characteristic, with fecal pellets included in the test. It has very few spicules. It is widely distributed in the Indian and Pacific Oceans. It has also been recorded in Caribbean mangroves (F. Monniot, 1983) and on the Salut Islands of French Guiana.

Lissoclinum fragile (Van Name, 1902)

Material.—Sierra Leone: mouth of Sierra Leone River, 15 m depth.

This species was unknown until now along the African coast, although its distribution is very wide elsewhere. Described from Bermuda, the species inhabits the Caribbean Sea and Brazil, and it has been recorded in the Philippines, Polynesia, New Caledonia, India, Madagascar, and Mayotte (Comoro Islands).

Polysyncraton reedi new species

Figures 1, 2

Material.—Senegal: off Cap Vert, 14°42.8'N–17°34.0'W, 50 m depth, collected by dredging.

Type.—MNHN n° A2 POL 52.

The species is dedicated to John Reed, the chief scientist of the cruise.

The species is thin and encrusting. The colonies are large (more than 10 cm across) but have been collected in pieces. The yellow-brown color of living colonies quickly disappears in formalin. Winding systems of zooids are inconspicuous at the colony surface. Their common cloacal openings are not visible. The common cloacal cavities spread widely at the thoracic level. Spicules (Fig. 1) are dense everywhere in the test. They are of two sizes: the most abundant average 40 μm across; larger, less common ones have more numerous rays and measure 120 to 150 μm across. The smaller spicules are star-shaped and the ends of their rays are divided in two or three or even four teeth. The larger spicules have a mulberry shape (Fig. 1).

The zooids (Fig. 2) lie in a single layer in the colony. Their oral apertures have six triangular lobes. There are generally 16 oral tentacles in three size-orders, of

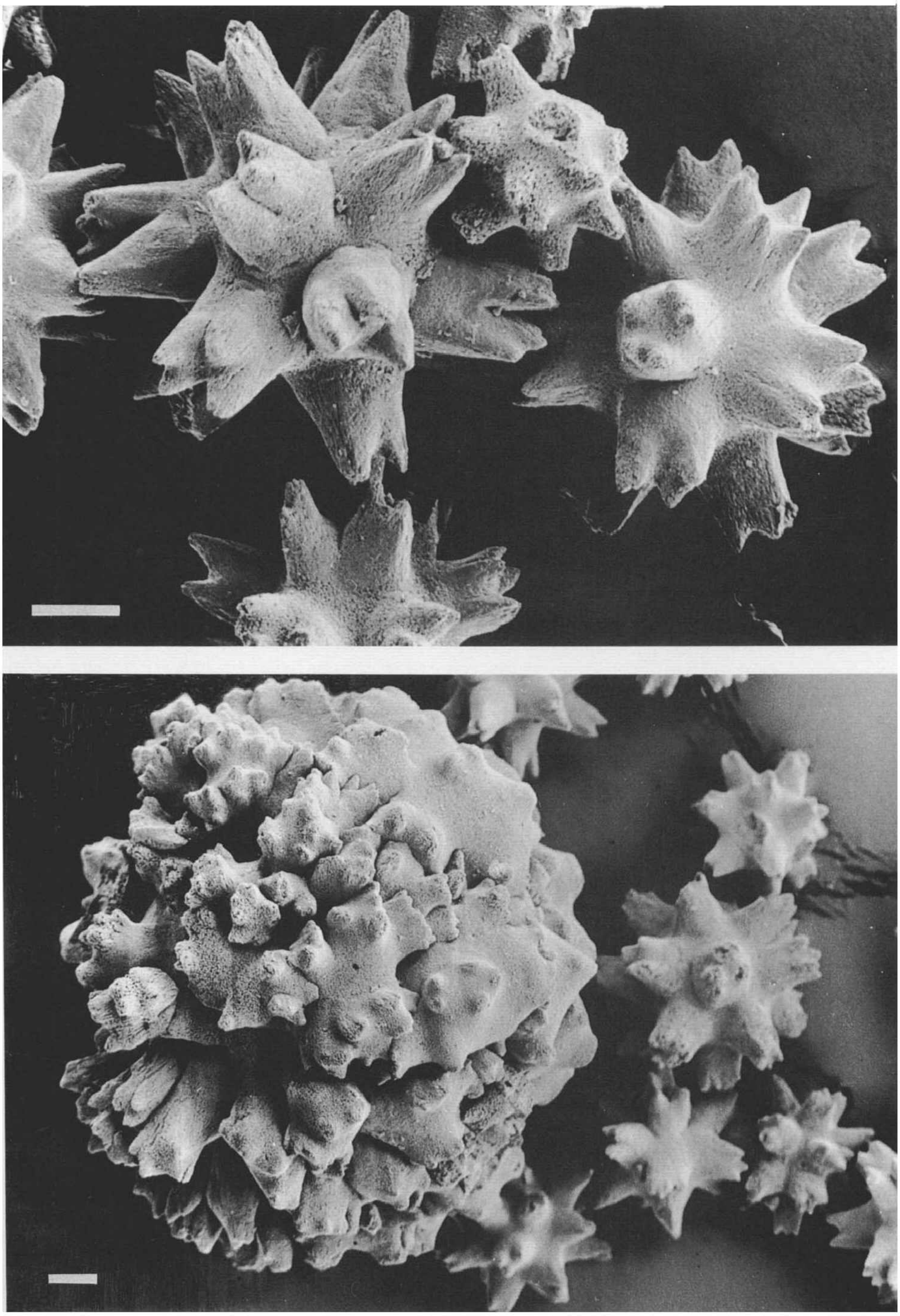

Figure 1. *Polysyncraton reedi* n. sp.: spicules. Scale = 10 μm.

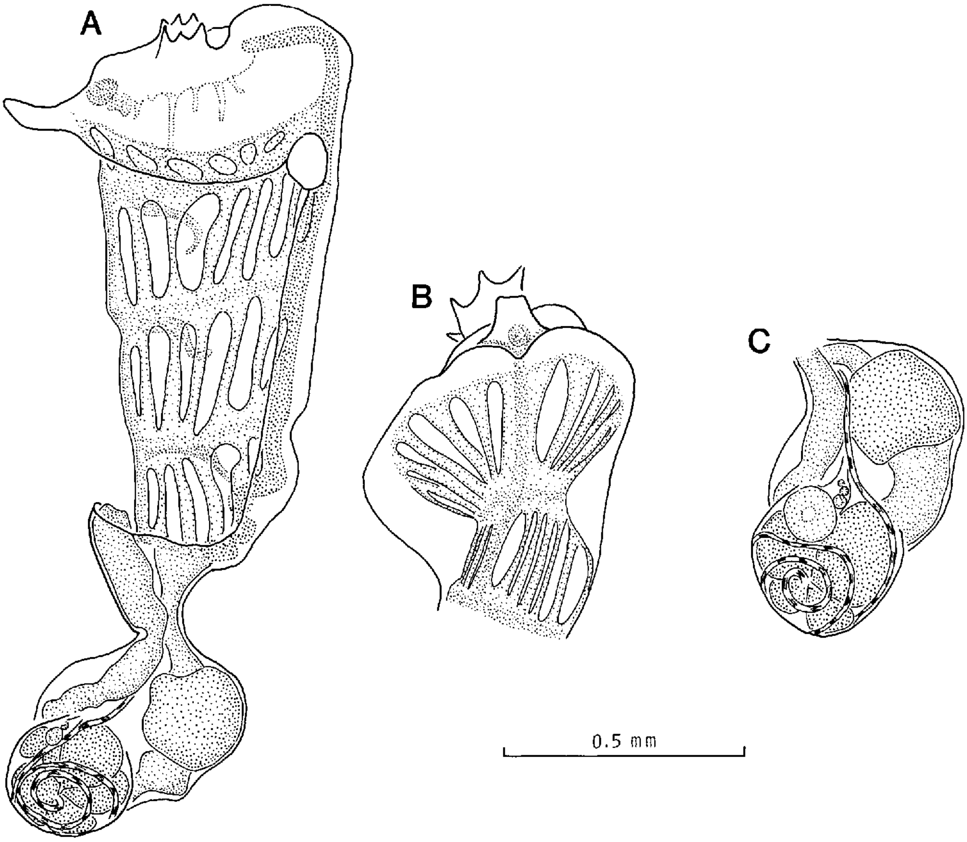

Figure 2. *Polysyncraton reedi* n. sp.: A, zooid; B, atrial lip; C, abdomen.

variable length and irregularly alternated. The cloacal opening is very wide and uncovers a large part of the branchial sac (Fig. 2A). The dorsal edge of the cloacal opening is enlarged and prolonged as a languet (Fig. 2B). The cup-like lateral thoracic organs lie at the edge of the body wall at the level of the first stigmata row or the first branchial bar (Fig. 2B). We have not found a thoracic appendage.

There are seven stigmata on each side of the branchial sac in the first row, fewer in the other rows. The esophago-rectal peduncle is short. The gut forms a flat loop, bent at right angles to the thorax. The gonads clearly protrude under the digestive loop (Fig. 2A, C). The testis is made of three to five or sometimes six closely packed lobes that make a spherical mass encircled by two or three turns of the sperm duct. The ovary is on the testis, inside the last turn of the sperm duct. The sperm duct curls toward the left or the right side, according to the individual (Fig. 2A, C). We have not found tadpoles.

Remarks.—This species differs from *P. lacazei* (Giard, 1872) by its color, the shape of the colony, the small number of turns of the sperm duct, the loss of a thoracic appendage and the form of the spicules. It also differs from *P. amethysteum* Van Name, 1902 by color, the cloacal languet, the thoracic appendage and the shape and size of the spicules. The new species cannot be confused with *P. haranti* Lafargue, 1975, which has a different colony structure and color and different gonads.

Polyclinum aurantium Milne-Edwards, 1841

Material.—Cape Verde Islands.

This species, known along the European Atlantic coast and the west coast of Africa, is recorded from the Cape Verde Islands for the first time.

Polyclinum sp.

Material.—Sierra Leone: Banana Island, 15–50 m depth.

The colonies are small cushions or encrusting masses. The zooids are arranged in circles. They have a typical *Polyclinum* shape, with a thorax twice the length of the abdomen, and a postabdomen with a narrow peduncule. The oral aperture has six triangular lobes. The wide cloacal aperture has a long languet with a wide base and either two distal teeth or a straight dentate edge. There is a button-like protrusion behind the posterior edge of the cloacal aperture. The muscles are weak, with eight longitudinal fibers. The muscles are thin and scarce on the atrial languet. The numerous oral tentacles are in three orders. The branchial sac has only 10 rows of 16 to 18 relatively short stigmata on each side. The anus opens at the level of the sixth transverse branchial vessel.

The abdomen is typical of the genus. The postabdomen is drop-shaped with a central ovary surrounded by about 12 testis vesicles. One or two larvae are incubated in the cloacal cavity. They have three adhesive and four large ectodermal papillae on each side. In addition, small papillae are spread in a postero-ventral crescent on the larval trunk. An ocellus and an otolith are present.

Remarks.—This species differs from *Polyclinum aurantium* and *P. aurantium joalense* in having fewer stigmata rows (Millar, 1953; F. Monniot, 1969) and different muscles, especially in the cloacal languet. Another difference can be seen in the larva: in *P. aurantium* a crystal (or two) of vaterite is included in the central mass of the larva, while in *Polyclinum* sp. from Sierra Leone rods of calcium carbonate are distributed everywhere in the larval epidermis and are easily seen under polarized light.

Ciona intestinalis (Linnaeus, 1767)

Material.—Cape Verde Islands: Fogo.

This species is recorded for the first time in the Cape Verde archipelago and has probably been carried there by shipping. It will be interesting to see if this species prospers there. *C. intestinalis* was not collected during the Harbor Branch cruise, nor by Lafargue and Wahl (1990); however, the species was previously common in the Dakar area (Pérès, 1949). *C. intestinalis* is a northern species. The Cape Verde Islands are currently its southern limit of distribution. It may be possible that its presence there is episodic; i.e., some animals arrive by ship and settle, grow and then disappear, and are eventually replaced by new arrivals.

Perophora multiclathrata (Sluiter, 1904)

Perophora bermudensis: Pérès, 1949: 190—Senegal.
Perophora africana Millar, 1953: 304, fig. 15—Ghana.

Material.—Sierra Leone: Banana Island.

This species is common in all warm seas.

Ecteinascidia turbinata Herdman, 1880

Material.—Senegal: Dakar.

This species is widely distributed in the Caribbean Sea and has been recorded several times in West Africa: Cape Verde Islands (Rennie and Wiseman, 1906), Dakar (Pérès, 1949), Lafargue and Wahl, 1990). It is also present in the Mediterranean Sea.

Ascidia aximensis Millar, 1953

Figure 3A, B

Ascidia aximensis Millar, 1953: 306, fig. 16—Ghana; 1965: 250, fig. 2—Ghana; part C. Monniot, 1969: 625, fig. 1D, 2G, H—Senegal.

Material.—Sierra Leone: Turtle Island, 60 m depth, 2 specimens.

Both specimens were 4 × 2.5 × 1 cm, lying with the left side against the bottom. The thin, transparent test is entirely encrusted with small pebbles on the left side, and on the right side has both sand grains and epibionts (polychaetes, bryozoans). The apertures are sand-free and slightly protruding; the oral siphon is terminal, and the cloacal siphon projects from the middle of the dorsal side, slightly to the left (Fig. 3A). The aperture lobes are flattened, with a pigment spot between each of them. The body wall is thin and transparent. On the right side the muscular fibers are long and anastomosed, while on the left side they are present only on the siphons (Fig. 3A). The oral tentacles, numbering at least 150, are long with joined bases, and of at least four orders. The peripharyngeal groove is close to the tentacular ring. It is bordered by inequal crests, the posterior one being higher. It makes a very shallow dorsal curve at the U-shaped dorsal tubercle. The dorsal ganglion is slightly closer to the cloacal aperture than to the oral. The dorsal lamina is high in the anterior part of the branchial sac, decreasing progressively toward the entrance of the esophageus and disappearing shortly beyond that. It has thickened folds on the left side, ending in papillae. Posteriorly to the esophagus entrance, along the left side of the dorsal lamina, the branchial tissue has an unperforated band. On the right side, from the esophagus to the bottom of the branchial sac, the transverse vessels end in papillae.

The branchial sac is pierced by a large hole facing the anus (Fig. 3B); this hole lies between the third and fourth longitudinal vessels and extends over at least 10 stigmata rows. It is lined by a flat tissue that has occasional, irregular stigmata. We have counted 50 longitudinal branchial vessels on the right side and 45 on the left. None connect the dorsal lamina. The internal branchial papillae are thick and long, without lateral diverticula. There are intermediate papillae of varied sizes but no parastigmatic vessels. There are five to seven stigmata in a mesh.

The digestive tract makes a closed loop. The stomach is globular with marked bulges (Fig. 3A, B). The transparent intestine ends in a smooth-edged anus. The ovary is concentrated inside the primary gut loop (Fig. 3A, B), while the testes spread over the digestive tract. Although testis and ovary are mature, the genital ducts are empty. The excretory vesicles are of a medium size and are only found around the stomach.

Remarks.—Previous descriptions of this species mentioned important variations. Millar (1953) considered the posterior position of the cloacal aperture as characteristic, but in 1965 he found it in the anterior half of the body. The two specimens from the reservoir of the Gorée (Dakar) laboratory have very differently

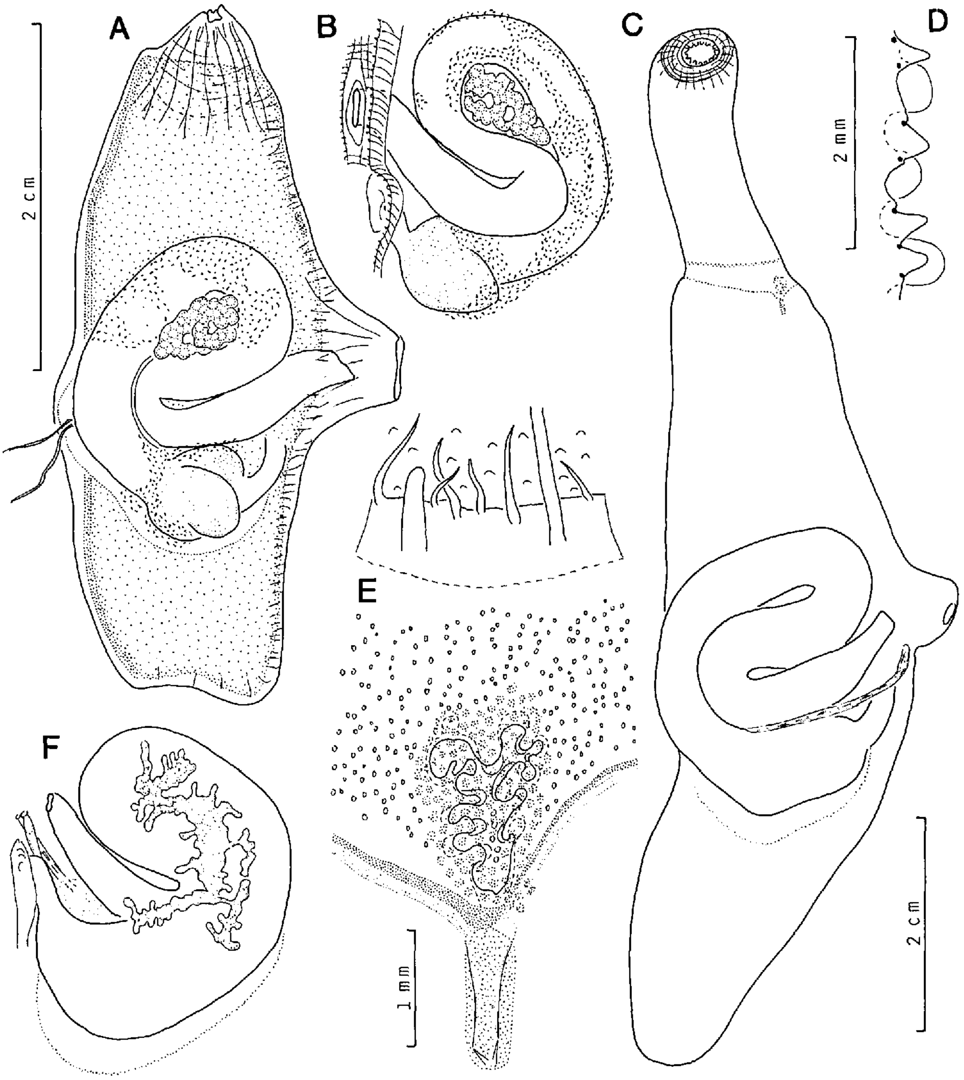

Figure 3. *Ascidia aximensis* Millar, 1953: A, left side, test removed; B, internal side of the gut; *Ascidia involuta* (Heller, 1875): C, left side; D, edge of the oral aperture; E, dorsal tubercle; F, internal side of the gut.

situated apertures (C. Monniot, 1969). In our Sierra Leone specimens the dorsal ganglion is very posterior. In contrast, Millar (1953) said that it lies near the dorsal tubercle, and in Dakar (1969) we found it one-third of the distance from the oral siphon to the cloacal siphon. Millar (1953) compared this species to *A. multitentaculatus* (Hartmeyer, 1919) from South Africa. Both species are similar in the large number of oral tentacles and in gut shape. *A. multitentaculatus* has stronger muscles, a dorsal ganglion close to the dorsal tubercle, a pronounced dorsal curve of the peripharyngeal groove, papillae around the dorsal tubercle, a low dorsal lamina, and intermediate papillae in the branchial sac.

The distinctive characteristics of *A. aximensis* are the large number of oral tentacles (150–200), its high dorsal lamina, and the shape of the gut and gonads.

Ascidia interrupta Heller, 1878

Material.—Azores: Sao Miguel Island.

The species was not found in the Azores in 1971. It may have been carried there recently by ships. The species was first found on the American tropical Atlantic coast. It was recorded from Congo by Millar, 1960.

Ascidia involuta Heller, 1875

Figure 3C–F

Ascidia involuta Heller, 1875: 114, pl. 3, figs. 4, 5—1 specimen of 15 cm—Adriatic Sea; Roule, 1884: 243—1 piece, Marseille, France; Monniot and Monniot, 1983: 100, fig. 20—anterior part of a specimen, Port Cros Island, France, Mediterranean Sea.

Ascidia conchilega: Pérès, 1957: 232—1 specimen, Balearic Islands.

Material.—Sierra Leone: Banana Island, 28 m depth.

The specimen, 10 cm long, was living on loose sediment. It was covered with coarse sand and shell fragments. The test is thin, colorless, and brittle. An internal thickening of the test surrounds the intestine as a crest. The body wall is very thin. The long oral siphon has muscles only distally (Fig. 3C); the lobes are retracted into the aperture, leaving an external row of sharp teeth with two pigment spots and an internal row of rounded teeth (Fig. 3D). The internal surface of the oral siphon is covered with small papillae. The short atrial siphon, far from the oral one, lacks lobes and muscles. The body musculature is made of two transverse bands on the right side, one ventral along the whole body length and one dorsal and anterior to the cloacal siphon. No muscles cross the mid-ventral line.

About 60 oral tentacles arise from a high membrane that makes a true oral diaphragm and has muscular fibers. The tentacles are long and sharp and are of at least four orders. The peripharyngeal groove lies rather far from the tentacles, and the interspace is covered by small papillae (Fig. 3E). The groove makes a shallow dorsal curve. The dorsal ganglion is very close to the dorsal tubercule. The dorsal tubercle's shape has been noted by all authors. The overall V-shape of the ciliated slit is complicated by windings and cryptic depressions. There are no accessory apertures from the neural duct into the cloacal cavity. The dorsal lamina is doubled in its anterior part and becomes a small high lamina beyond the dorsal ganglion. The dorsal lamina encircles the entrance of the esophagus before diminishing and ending at the bottom of the branchial sac. On the right side, at the level of the esophagus entrance is a row of long papillae. Posteriorly smaller papillae face the dorsal lamina on each side of an unperforated area where the retropharyngael groove lies.

The branchial sac extends behind the gut, with a thick and undulated wall. More than 100 longitudinal vessels occur on each side. There are only primary papillae, which are thick, protruding, and slightly flattened laterally. The branchial meshes are elongated transversely and narrow with four to six short stigmata. There are no parastigmatic vessels.

The digestive tract (Fig. 3F) is massive, without an intestinal enlargment. The intestinal wall is thin. Laterally, its contents are visible; medially, the gut is rendered opaque by a continuous layer comprising small accumulation vesicles, pyloric tubules, and the testis. The accumulation vesicles extend onto the body wall between the esophagus and rectum. The anus is a simple hole.

The gonads are not well developed; the ovary is internal and the testis is diffuse. The genital ducts do not follow the rectum, and they open side by side far from the anus (Fig. 3F).

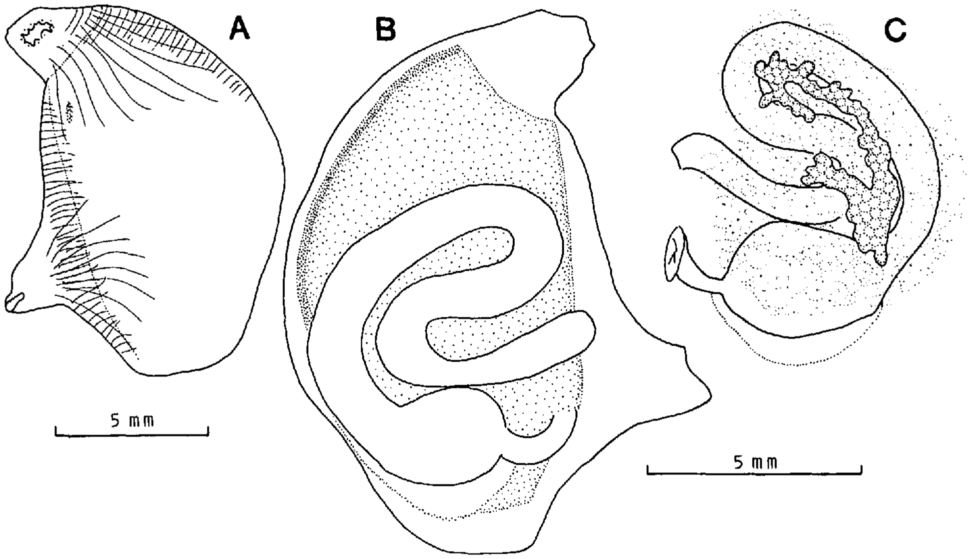

Figure 4. *Ascidia prona* n. sp.: A, right side; B, left side; C, internal side of the gut.

Remarks.—Ascidia involuta has not been fully described until now. It has been known only from the Mediterranean Sea, and so its presence in Sierra Leone considerably increases its known distribution. It is probably more abundant than the few previous collections have indicated. A very brittle species, it is most often collected in pieces, making it hard to recognize in a dredge sample.

Ascidia prona new species
Figure 4

Ascidia sp. C. Monniot, 1969: 627, fig. 1C—Senegal.

Material.—Senegal: Cap Vert, Madeleine Island, 14°39.2′N–17°28.3′W, 0–2 m depth.

Type.—MNHM n° P5 ASC.A 252.

The specimen was attached to a small stone. The translucent test is covered with sand grains. The lobes of the apertures are not clearly visible. Red pigment spots are located between the eight oral lobes.

Muscles are lacking on the left side, and on the right they are limited to a strip of transverse fibers along the dorsal side and a similar strip along the anterior third of the ventral side (Fig. 4A). The radial muscles on each aperture are short.

There are about 70 long oral tentacles with joined bases, of three or four orders. The peripharyngeal groove has two equal crests. It approaches the tentacles, dorsally where it makes a shallow curve around the C-shaped dorsal tubercle. The dorsal lamina comprises two sheets as far as the dorsal ganglion, which lies far from the dorsal tubercle. Further back the dorsal lamina is a single low sheet bordered with small papillae. Its height rapidly decreases beyond the opening of the esophagus. At this level, on the right side, the transverse vessels have long papillae.

On the right side of the branchial sac, the longitudinal vessels unite with the dorsal lamina. They are more numerous in the posterior part of the body (45 on the right side and 40 on the left). Minute plications of the branchial wall are inconspicuous. There are four to six stigmata in a mesh. The internal papillae are long, without lateral diverticula. Parastigmatic vessels and intermediate papillae only appear where a stigmata row divides.

The parts of the digestive loop are well demarcated (Fig. 4B). The stomach is enlarged and has a smooth wall; the anus is smooth-edged. The gut is surrounded by large accumulation vesicles (Fig. 4C). In this specimen the gonads are poorly developed; the ovary occupies the whole primary digestive loop and overlaps onto the secondary loop. Testes are not visible in this specimen. The genital ducts are empty.

Remarks.—We note some differences from the specimen described in 1969, which was more mature and had dilated gonad ducts. In the new specimen the papillae of the dorsal lamina are shorter and there are no secondary branchial papillae apart from those on transverse sinuses. The new specimen confirms the location of the ovary, which for the most part lies very posteriorly in the primary intestinal loop and projects at the bottom of the secondary loop.

This species is most remarkable for the weakness of its mantle musculature, its deeply curved gut, the position of its gonads, and the size and abundance of the accumulation vesicles around the intestine. No other Atlantic species has these characters. This species is more closely related to Australian or circumtropical species such as *A. dorsalis* and *A. archaia* but has a more deeply curved digestive tract. The species name refers to this pronounced curve.

Ascidia sydneiensis Stimpson, 1855

Ascidia obliqua: Rennie and Wiseman, 1906: 905, figs. 10, 11—Cape Verde Islands.

Material.—Cape Verde Islands: Fogo and Sao Tiago; Sierra Leone: Banana Island.

A. sydneiensis is distributed in all warm seas. It is well characterized by its musculature and its swollen posterior intestine.

Ascidiella aspersa (Müller, 1776)

Material.—Senegal: southwest coast of Cap Vert.

The Dakar area seems to be the southern boundary of this north-temperate species.

Botryllus niger (Herdman, 1886)

Material.—Cape Verde Islands: Sao Vicente.

This species is known from all tropical seas under the name *Botrylloides nigrum*. Several specimens, probably of this species, were also collected in Senegal and Sierra Leone, but because they were without gonads their identification cannot be confirmed.

Distomus rudentiformis (Sluiter, 1915)

Material.—Sierra Leone: Freetown.

This species seems to be endemic to the west African coast from Senegal to Sierra Leone.

Polycarpa anguinea (Sluiter, 1898)
Figure 5

Styela (*Polycarpa*) *anguinea* Sluiter, 1898a: 52, pl. 6, figs. 15–19—South Africa: Krysna.
? *Styela* (*Polycarpa*) *nivosa* Sluiter, 1898b: 12, pl. 1, fig. 9, pl. 3, fig. 46—Caribbean area.
? *Gynandrocarpa maxima* Sluiter, 1904: 93, pl. 15, figs. 5–7—Indonesia.
Polyandrocarpa maxima: Van Name, 1918: 103, pl. 31, fig. 33—Philippines; 1921: 412, figs. 82, 83—Florida.
? *Polycarpa anguinea suesana* Michaelsen, 1918a: 85, fig. 15—Red Sea.
Polycarpa anguinea: Millar, 1955: 203, fig. 28—South Africa; 1958: 507, fig. 6—Brazil: Santos; Monniot and Monniot, 1976: 370, fig. 2B—Mozambique: Inhaca.
Polyandrocarpa anguinea: Millar, 1962: 186—South Africa, Mozambique; Vasseur, 1967: 113, pl. 4, figs. 30–32—Mauritius; Rodrigues, 1977: 721, figs. 1–16—Brazil.
Polyandrocarpa (*Polyandrocarpa*) *sagamiensis* Tokioka, 1953: 246, pl. 47, figs. 1–6—Japan.
Polyandrocarpa (*Polyandrocarpa*) *rollandi* Tokioka, 1961: 116, fig. 8—New Caledonia.
? *Polyandrocarpa* (*Polyandrocarpa*) *rollandi solitaria* Tokioka, 1961: 119, fig. 9—New Caledonia.
Polycarpa nivosa?: C. Monniot, 1983: 447, figs. 9E, F—Martinique.
Polyandrocarpa sagamiensis: Kott, 1985: 220, fig. 103—Queensland.
Polyandrocarpa rollandi: C. Monniot, 1987: 303, fig. 12—New Caledonia.

Material.—Sierra Leone: Freetown and Banana Island.

The individuals are agglomerated in a common test. The test is hard, 2-mm thick, clean and without sediment. Even when contracted the siphons are long. The limits between adjacent zooids cannot be seen inside the tunic. The body wall is thin, brittle, and with few muscles. We counted 30 to 40 thick oral tentacles in three or four orders of size at the base of a crest where even more tiny button-like tentacles may be found. The peripharyngeal groove has a single crest and makes a deep dorsal V. The U-shaped dorsal tubercle is opened anteriorly and protruding. The dorsal lamina is long and thin and begins at some distance from the peripharyngeal groove. It fuses to the first branchial fold on the left side. The esophagus entrance is surrounded by an imperforated ring of branchial wall delimited by a small groove. The branchial folds stop abruptly at this imperforated surface. The thin branchial wall has four folds per side. In the middle of the body we have counted:

R.E. 10 (10+6) 8 (12+3) 7 (13+2) 6 (9) 5 DL.
L.E. 5 (7+5) 8 (14+3) 7 (12+3) 12 (9) 8 DL.

The folds are low. Under the dorsal side of each fold there is a small secondary fold where new longitudinal vessels are formed. Posteriorly, these secondary folds may part from their main folds. The first vessels on each side of the dorsal lamina are parallel to it. The first fold on each side lies farthest from the dorsal lamina in the middle level of the branchial sac. In the space left between the first vessel and the first fold, other vessels appear (four on the right and seven on the left), the longest ones close to the fold. The elongated branchial meshes have three to five stigmata between the folds and two stigmata on the folds. The parastigmatic vessels are not constant.

The gut is linked to the body wall only by a few trabeculae. In most cases (Fig. 5A) the intestine forms a double loop, rarely a single loop (Fig. 5B). The stomach has parallel internal ridges and it narrows only gradually into the intestine. The edge of the anus is rolled and smooth (Fig. 5A) or slightly frilled (Fig. 5B).

The gonads hang between the branchial sac and the body wall, attached to the body wall by thin vascular processes. These somewhat elongated polycarps (Fig. 5C) are irregularly arranged; they are more numerous on the right than on the left side (Fig. 5A, B). There is no trace of endocarps.

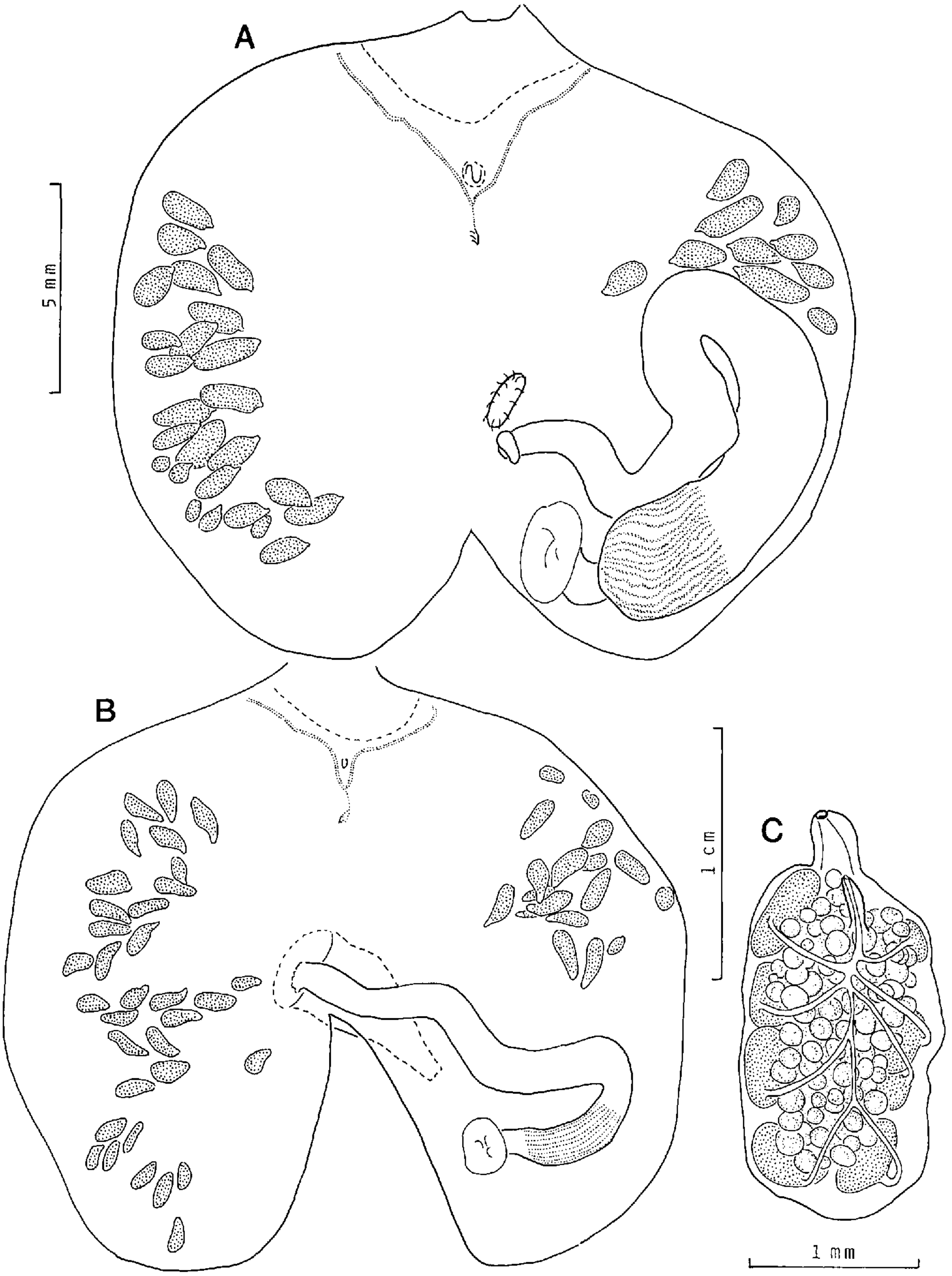

Figure 5. *Polycarpa anguinea* (Sluiter, 1898): A and B, two specimens opened along ventral side; C, polycarp.

Remarks.—Several agglomerated *Polycarpa* species have been described in the world, that lack endocarps and have gonads hanging between the body wall and the branchial sac. According to the authors' opinions about their solitary or colonial habits, these species were placed in the genera *Polycarpa* or *Polyandro-*

carpa. Budding has never been proved for any of these species, so we place them in the genus *Polycarpa.*

The specimens from Sierra Leone are the first representatives of this group to be recorded on the West African coast. They may have been introduced by ships. We have reexamined specimens of several species in this same group collected from different areas (Europe, West Indies, Brazil, Mozambique, Indonesia, Hawaii, and New Caledonia). All samples show a large variability of the digestive tract, which in a single aggregate may form a double loop, a single loop, or an almost straight tube. The shape of the gut generally is a good taxonomic trait, but evidently is of no use here. The same is true for the number and the place of the gonads, especially on the left side where they develop into the space left by the gut. On the contrary, gonad alignment seems to be of great taxonomic value.

The most important characters, in our opinion, are the occurrence of additional longitudinal branchial vessels between the first (most dorsal) vessel and the first branchial fold, and the gonad line. We separate three species: 1) *Polycarpa gracilis* Heller, 1877, European, with gonads irregularly arranged and without additional longitudinal branchial vessels. 2) *Polycarpa anguinea* (Sluiter, 1898), tropical worldwide, with gonads irregularly arranged and with additional vessels. 3) *Polycarpa* or *Polyandrocarpa lapidosa* (Herdman, 1886), Australian, with few gonads arranged in parallel rows and with a maximum of one to two vessels between the dorsal lamina and the first branchial fold.

Polyandrocarpa watsonia Kott, 1985 may only be a peculiar form of *P. lapidosa.*

Polycarpa arnoldi (Michaelsen, 1914).

Material.—Cape Verde Islands: Santa Clara Bay on Sao Tiago, 18 m depth.

This species is recorded for the second time in the eastern Atlantic, having been found already near Annobon, in the Gulf of Guinea. It is abundant in the Caribbean Sea.

Polycarpa goreensis (Hartmeyer, 1914)

Figure 6

Pandocia goreensis Michaelsen, 1914: 425.

Polycarpa goreensis: Michaelsen, 1915: 398, fig. 4, pl. 16, fig. 1; Millar, 1965: 251; C. Monniot, 1969: 638, fig. 7D.

Polycarpa marioni Pérès, 1951: 1066, fig. 7.

Polycarpa marchadi C. Monniot, 1969: 640, fig. 8.

Material.—Specimens from Dakar, collected by K. D. Leung Tack; specimens from Tangier (Morocco) collected by H. Zibrowius. The type specimens of *P. marioni* and *P. marchadi* have been reexamined.

About 40 tentacles of three orders, with some very small ones between them, project from the base of a ring-like velum. The peripharyngeal groove has a single crest. It forms a shallow dorsal V (Fig. 6A, B). The dorsal tubercle is C-shaped and open anteriorly. The dorsal lamina is a thin membrane that increases in height toward the esophagus entrance, which it encircles.

The branchial sac has four high folds in most specimens. They are low and rounded in the type of *P. marchadi.* In all cases, there are only one or two high longitudinal branchial vessels between the folds. They are absent between the dorsal lamina and the first folds on each side. On the right side the fold moves away from the dorsal lamina, with 10 stigmata in the interval anteriorly and up to 25 near the esophagus. Moreover, on the right side, a triangular unperforated area exists directly against the dorsal lamina.

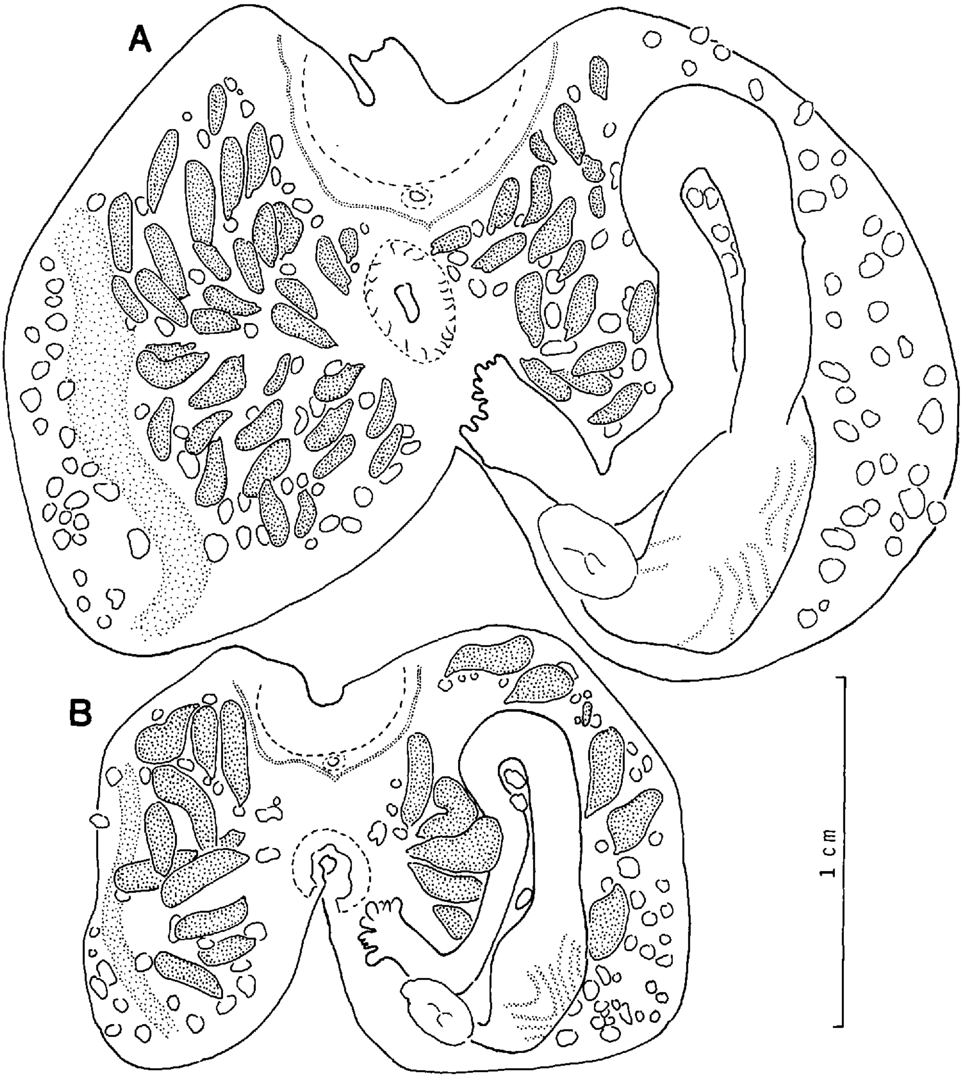

Figure 6. A, *Polycarpa goreensis* (Michaelsen, 1914) from Dakar; B, *Polycarpa goreensis* ? from Tanger Harbor.

The digestive tract (Fig. 6A) occupies much of the left side of the body, far from the endostyle but close to the peripharyngeal groove. The oval stomach has sinuous internal ridges but only on the ventral side. There is no caecum. The rectum, loosely attached to the body wall, ends in a wide anus with hem edged lobes. Michaelsen's (1915) figure 4 shows a slightly lobed anus.

The gonad number is variable. Fifty were counted in Michaelsen's type specimen; C. Monniot (1969) reports 40 on the right and 20 on the left; another specimen has 36 on the right and 16 on the left (coll. Leung Tack); there are 20–30 on the right and 12–15 on the left in the *P. marchadi* type specimens, and 17 on the right and 14 on the left in the type specimen of *P. marioni*. These gonads are elongated, with an internal ovary flanked by two testis rows. They are attached to the body wall only by short vascular trabeculae.

The heart is large and elongated. Endocarps surround the gonads and lie inside the gut loop; they are more numerous on each side of the endostyle, lying between it and the heart and the gut. A small velum at the base of the cloacal aperture carries a ring of thin tentacles.

Remarks.—We place in this species a small (1.5 cm) specimen (Fig. 6B) found in Tangier Harbor by H. Zibrowius. Its branchial structure is identical, with only one very high longitudinal vessel between each fold. The gonads, which are mature, are less numerous, 11 on the right and 10 on the left. It has gonads between the gut and the endostyle, unlike any specimen from West Africa.

Polycarpa longitubis Monniot, Monniot and Leung Tack, 1987

Material.—Senegal: sand-mud bottoms south of Dakar, K. D. Leung Tack collection.

This small species attains only 15 mm between its opposite siphons. The length of the siphons suggests that the animals live buried in sediment. The species can be very abundant, with a hundred to a thousand individuals taken in a single dredging.

Polycarpa sourieri Pérès, 1949

Material.—Senegal: sediments south of Dakar, K. D. Leung Tack collection.

The newly collected specimens confirm the previous descriptions. The species is characterized by its globular polycarps.

Polycarpa translucida (Pérès, 1951)
Figure 7

Cnemidocarpa translucida Pérès, 1951: 1067, figs. 2–9.
Polycarpa translucida: Millar, 1957: 372, fig. 4.

Material.—Senegal: Dakar, K. D. Leung Tack collection. The type specimen is lost.

The species has a characteristic shape with both apertures close together at the top of an elongated body. The posterior part of the test is densely encrusted with sediment and has some rhizoids, whereas the anterior half is almost clean and translucent. The test is thin. The muscles make a thin, even regular web of longitudinal and transverse fibers on the whole body wall. The longitudinal muscles are slightly stronger.

Thirty to 40 stout oral tentacles of three orders project from the base of a short velum. The peripharyngeal groove has two crests, the anterior one thicker, it does not curve dorsally. The dorsal tubercule is large and protruding, with a C-shaped aperture or a simple hole. The dorsal lamina is long, high and smooth and encircles the esophagus entrance.

The branchial sac has four unequal folds. In the anterior part we counted:

R.E. 1 (7) 3 (9) 3 (8) 4 (14) 3 D.L. 3 (20) 6 (6) 4 (8) 3 (7) 2 E.L.

Only the first fold is high; the second and fourth folds do not reach the posterior part of the branchial sac. The first longitudinal vessel on the right side slightly moves apart from the dorsal lamina, with 12 stigmata anteriorly and 16 posteriorly. The meshes have six to eight stigmata between the folds, but only one or two on the folds, where the vessels are very close together.

The gut (Fig. 7A, B) is unusually posterior. The esophagus is very bent and the stomach is slightly enlarged, with numerous internal ridges. Hidden under the stomach, a small outgrowth represents the caecum. The long rectum is only loosely

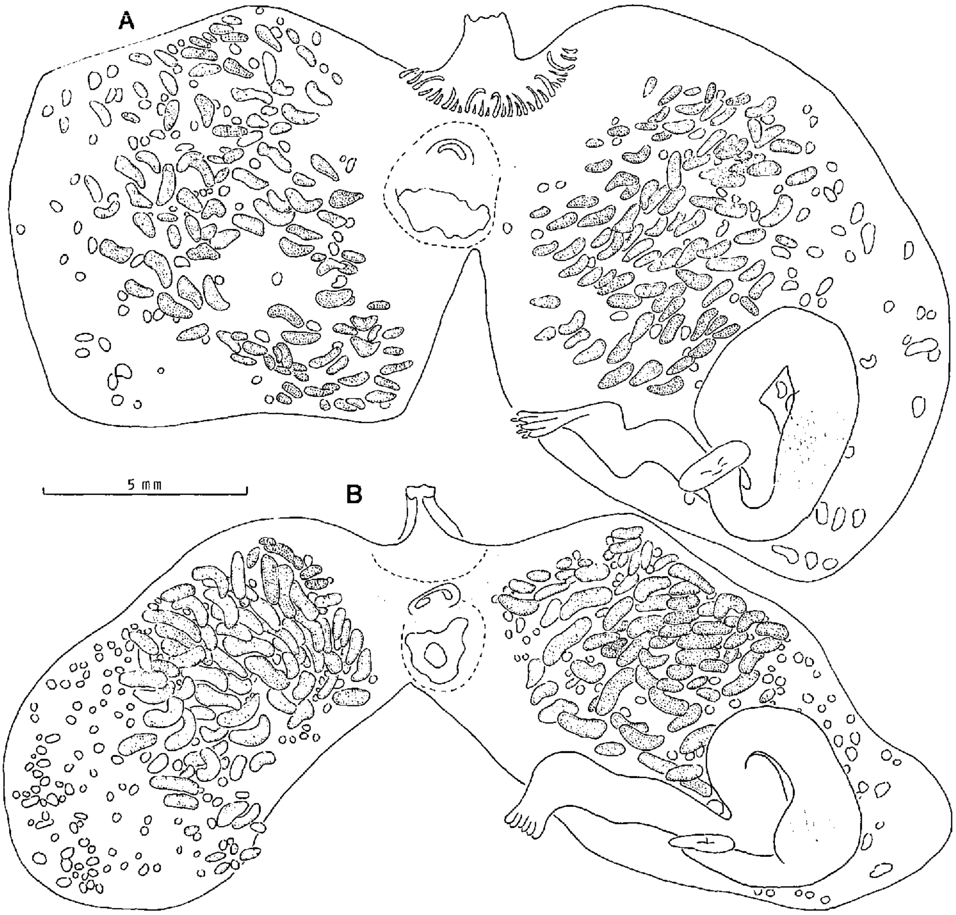

Figure 7. *Polycarpa translucida* (Pérès, 1951): A and B, two specimens opened along ventral side.

attached to the body wall, and it opens in a wide anus bordered with finger-like lobes (Fig. 7A, B).

The gonads are numerous (111 on the right and 90 on the left, Fig. 7A; 82 and 78, Fig. 7B). The elongated polycarps are fixed to the body wall by their distal part and stand erect in the cloacal cavity. The dermato-branchial trabeculae are not numerous; some arise from the polycarps, others from the body wall to reach the branchial tissue. Most polycarps are not linked this way to the branchial sac.

The endocarps are small, not numerous, and widespread. The cloacal aperture is encircled by a velum; we have not seen cloacal tentacles.

Remarks.—Pérès' (1951) specimen has few gonads, all placed in an equatorial belt. By all the remaining characters, it corresponds to the newly collected animals. Both specimens described by Millar (1957) from Sierra Leone also have numerous gonads everywhere on the body wall.

Cnemidocarpa irene (Hartmeyer, 1906)

Cnemidocarpa irene: Nishikawa, 1991: 96 (synonymy).
? *Styela* (*Cnemidocarpa*) *maroccana* Sluiter, 1927: 61, pl. 6, figs. 1, 2—Morocco.

Material.—Cape Verde Islands: Sao Tiago, 0–15 m depth; Sao Vicente 10 m depth.

Recently, when revising the Japanese ascidian fauna Nishikawa (1991) studied the Hartmeyer's type specimen and showed the synonymy of *C. irene* with *C. areolata* (non Heller, 1878, numerous authors) and *C. valborg.*

The Cape Verde Islands specimens correspond well to the numerous descriptions of this species, which is very common in the Indo-Pacific Ocean but has only been recorded in the Caribbean area of the Atlantic (Monniot and Monniot, 1984, as *C. valborg*). It was probably introduced there and to West Africa by shipping. Except for this species, the genus *Cnemidocarpa* is not known in the tropical Atlantic.

Sluiter (1927) described *Styela* (*Cnemidocarpa*) *maroccana* (the type specimen seems to be lost), which is characterized by four gonads arranged in a span on the right side and, on the left, only one gonad, lying at right angles to the posterior intestine (according to Sluiter's very schematic drawing). Generally *C. irene* has three (two to four) right gonads and two left gonads with the posterior left one parallel to the posterior intestine. Sluiter's drawing also shows a long stomach slightly enlarged in its cardiac part, but in the text he says "long et spacieux au niveau de la partie pylorique" ! He also mentions a simple anus with long filaments. It may be that the dissection left part of the dorsal lamina attached to the anus. All other characters of *C. maroccana* well correspond with those of *C. irene.* Quite often, Sluiter's descriptions and drawings are rather different from the type specimens he is presenting. If the description is exact in this case, *C. maroccana* is an atypical specimen of *C. irene.*

Styela canopus (Savigny, 1816)

This species is abundant in Senegal and Sierra Leone. It has been recorded widely under the name *Styela partita* (Stimpson, 1852).

Hartmeyeria hupferi (Hartmeyer, 1909)

Material.—Senegal: sediments south of Dakar, K. D. Leung Tack collection.

This is a sandy-bottom species about 1 cm in diameter, easy to recognize by its rather triangular shape. The test is covered with sand, carries a crest at the top, and has a sand-free, ramified pedunculate holdfast.

Microcosmus claudicans (Savigny, 1816)

Material.—Senegal: Cap Vert, 60 m depth, collected by dredging.

Dakar is the southernmost record for this species. Its distribution and differences with *M. savignyi* are discussed below.

Microcosmus exasperatus Heller, 1878

Material.—Sierra Leone: Freetown.

This species is present in all warm, very shallow seas. It is especially common in harbors and on ship hulls. Surprisingly, it has not been recorded previously from the west coast of Africa, although it is known from South Africa and has now arrived in the Mediterranean Sea.

Microcosmus helleri Herdman, 1881

Microcosmus helleri Herdman, 1881: 54; 1882: 131, pl. 45, figs. 1–4—Northern Australia; Van Name, 1921: 463, figs. 145, 146—West Indies; 1930: 503, figs. 69, 70—West Indies; Millar, 1977: 215, fig. 32—Brazil; Kott, 1985: 349, fig. 173—Australia.

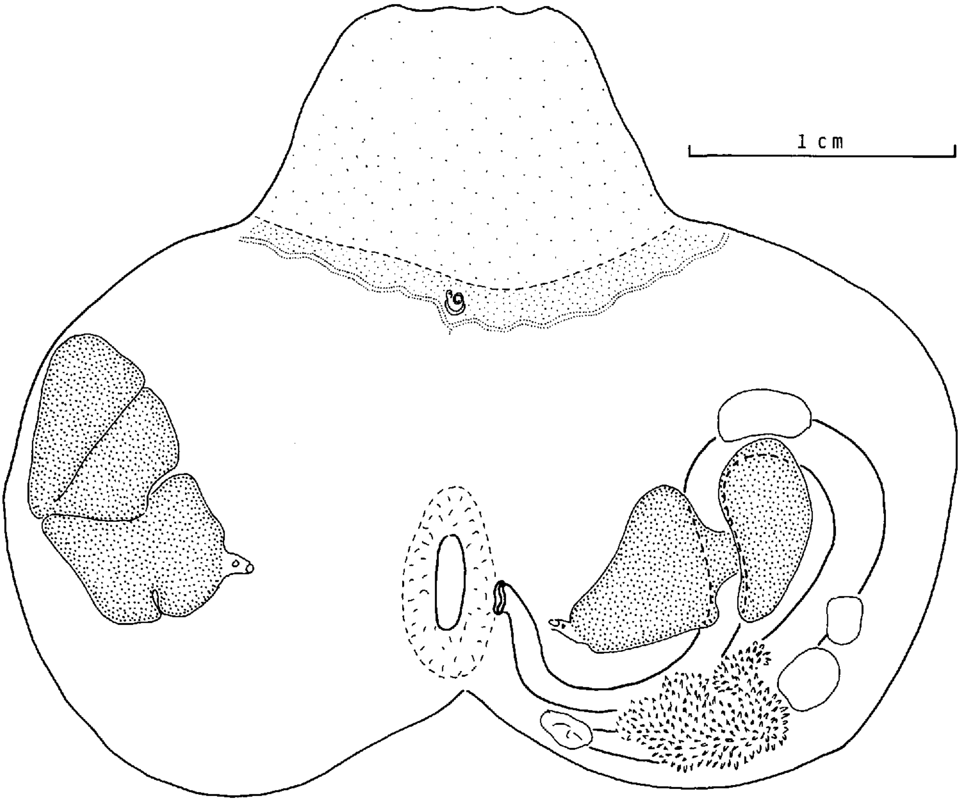

Figure 8. *Microcosmus savignyi* Monniot, 1962.

Microcosmus goanus Michaelsen, 1918b: 12, figs. 1, 2—Australia; C. Monniot, 1970: 49, fig. 9c—Brazil; 1983: 1036, figs. 5B, C—West Indies.

Material.—Senegal, south of Cap Vert, 60 m depth, collected by dredging.

M. helleri is often found living on loose sediments or weakly attached to shells or sea-weeds. The test is covered by all kinds of debris. *M. helleri* has been described from Northern Australia, from an unusually clean surfaced specimen. *M. goanus,* also Australian, is covered with debris. Kott (1985) revised the type specimen of *M. helleri,* and examined Caribbean specimens and she confirms the synonymy.

In the Atlantic, *M. helleri* has been recorded only from Brazil to Florida. It may have been introduced into Senegal.

The purple color inside the siphons and the body wall's transparency distinguish this species quickly from *M. polymorphus,* the other species of *Microcosmus* with six branchial folds.

Microcosmus savignyi Monniot, 1962
Figure 8

Material.—Cape Verde Islands: Boa Vista, 15 m depth.

The specimen (3 × 2.2 cm) was erect, attached by its left posterior side. The distance between the apertures is 2 cm. The siphons cannot be retracted.

M. savignyi which was only recorded from the Mediterranean Sea is closely related to *M. claudicans* (Savigny, 1816). These species differ by the left gonad being more reduced in *M. savignyi. M. savignyi*'s endocarps are all closely associated with the gut or gonads. These species also differ in the shape of the spinules (Turon, 1987). Both species differ from the cosmopolitan *M. exasperatus* in having papillae on the branchial transverse bars.

M. claudicans sensu stricto inhabits the European Atlantic coast from Scotland to Spain. *M. savignyi* lives in the eastern Mediterranean Sea, around Naples, and in the Golfe du Lion. Both species have been collected along the Spanish Mediterranean coast (Turon, 1987; Ramos, 1988) and near Banyuls (C. Monniot, 1962). One specimen of *M. claudicans* was reported from the Atlantic coast of Morocco by Sluiter (1927) but without any description.

Pyura hupferi Michaelsen, 1908

Pyura vittata: Peres, 1948: 93—Senegal.
Part *Pyura dura:* C. Monniot, 1965: 88, fig. 27—specimens from Dakar.
Pyura dura: C. Monniot, 1969: 645, fig. 10—Senegal; Lafargue and Wahl, 1990: 395—Senegal.

Material.—Senegal: Dakar; Sierra Leone.

This beautiful species, reddish with a hard tunic, has a characteristic shape when uncrowded. The body is conical, widening to the top, where there are two large, conical siphons. This species is known only from this area.

Pyura praia Monniot and Monniot, 1968

Material.—Cape Verde Islands: Sao Vincente, Sao Tiago and Sal.

This species was described originally from Boa Vista Island and from Praia Harbor on Sao Tiago Island. Its occurrence on other islands indicates how it is widely present in the archipelago, where it seems endemic. It is the only Atlantic species of *Pyura* with so many branchial folds (9 to 11 on each side).

Pyura stolonifera (Heller, 1878)

Material.—Senegal: Dakar.

This is the largest African pyurid; some specimens are larger than 10 cm across. The test is thick, hard, and sometimes encrusted with sand. It seems to have originated from South Africa and has colonized the west coast of Africa up to Dakar and the strait of Gibraltar (C. Monniot and Bitar, 1983).

Herdmania momus (Savigny, 1816)

Material.—Cape Verde Islands: Sao Tiago and Razo.

One of the commonest ascidian species in tropical seas, except on the west coast of Africa, it often lives on ship hulls. It has not previously been recorded from the Cape Verde archipelago.

Gamaster dakarensis Pizon, 1896

Material.—Senegal: sandy bottoms south of Dakar, K. D. Leung Tack collection.

This species is relatively abundant around Dakar. Its range extends from Namibia to Brittany.

Molgula helleri Drasche, 1885

Material.—Senegal: off Casamance, 20 m depth, K. D. Leung Tack collection.

This rare species, already recorded here, also inhabits the Mediterranean Sea.

Molgula occidentalis Traustedt, 1882

Material.—Senegal: Cayar canyon, collected by dredging, 35 m depth.

This species has been recorded previously along the west coast of Africa.

Molgula occulta Kupffer, 1875

Molgula africana Sluiter, 1915: 38, pl. 4, figs. 1–4—Senegal.
Molgula hannensis Pérès, 1949: 191, fig. 15—Dakar; Millar, 1956: 415, fig. 5—Sierra Leone.

Material.—Senegal: sandy bottoms south of Dakar, R/V SEA DIVER and K. D. Leung Tack collections.

This species is abundant on sandy bottoms, with more than 500 specimens taken in a single dredging.

ACKNOWLEDGMENTS

We thank the Harbor Branch Oceanographic Institution for having invited one of us (F.M.) on the African expedition; chief scientist J. Reed for assisting in the translation; and T. Newberry, University of California Santa Cruz, for pertinent remarks and editorial assistance.

LITERATURE CITED

Heller, C. 1875. Untersuchungen über des Tunicaten des Adriatischen Meeres II. Denkschr. K. Akad. Wiss., Wien 34: 107–125.

Herdman, W. A. 1881. Preliminary report on the Tunicata of the Challenger expedition. Part III. Proc. Roy. Soc. Edinburg. 11: 52–88.

———. 1882. Report on the Tunicata collected during the voyage of H.M.S. Challenger during the years 1873–1876. Part. 1, Ascidiae simplices. Rep. Challenger Exped. Zool. 6(17): 1–296.

Kott, P. 1985. The Australian Ascidiacea Part. I. Phlebobranchiata and Stolidobranchiata. Mem. Qd. Mus. 23: 1–440.

Lafargue, F. and W. Wahl. 1990. Contribution to the knowledge of littoral ascidians (Ascidiacea, Tunicata) of the Senegalese coast. Bull. Inst. Fondam. Af. Noire 46, A(3–4): 385–402.

Michaelsen, W. 1914. Ueber einige westafrikanische Ascidien. Zool. Anz. 43: 423–432.

———. 1915. Tunicata. *In* Beiträge zur Kenntnis der Meeresfauna Westafrikas 1(3): 322–518. L. Friederichsen and Co., Hamburg.

———. 1918a. Ascidia Ptychobranchia und Diktyobranchia des Roten Meeres. Denkschr. Akad. Wiss., Wien 95: 1–121.

———. 1918b. Die Ptychobranchen und Diktyobranchen Ascidien des westlichen Indischen Ozeans. Jb. Hamb. Wiss. Anst. 35(2): 1–17.

Millar, R. H. 1953. On a collection of ascidians from the Gold Coast. Proc. Zool. Soc. Lond. 123(2): 277–325.

———. 1955. On a collection of ascidians from South Africa. Proc. Zool. Soc. Lond. 125(1): 169–221.

———. 1956. Notes on some ascidians from Sierra Leone and Gambia. Ann. Mag. Nat. Hist. 12th Ser. 9: 409–417.

———. 1957. Further notes on ascidians from Sierra Leone. Ann. Mag. Nat. Hist. 12th Ser. 10: 369–377.

———. 1958. Some ascidians from Brazil. Ann. Mag. Nat. Hist. 13th Ser. 1: 497–514.

———. 1960. Ascidiacea. "Discovery" Rep. 30: 1–160.

———. 1962. Further descriptions of South African ascidians. Ann. S. Af. Mus. 46(7): 113–221.

———. 1965. Ascidians from the tropical coast of west Africa. "Atlantide" Rep. 8: 247–255.

———. 1977. Ascidians (Tunicata: Ascidiacea) from the northern and north-eastern Brazilian shelf. J. Nat. Hist. 11(2): 169–223.

Monniot, C. 1962. Les *Microcosmus* des côtes de France. Vie Milieu 13(3): 397–432.

———. 1965. Etude systématique et évolutive de la famille des Pyuridae (Ascidiacea). Mém. Mus. Natl. Hist. Nat., Paris A 36: 1–203.

———. 1969. Sur une collection d'ascidies de Dakar (Phlébobranches et Stolidobranches). Bull. Mus. Natl. Hist. Nat., Paris 2 ème Sér. 41(3): 622–654.

———. 1970. Ascidies phlébobranches et stolidobranches. *In* Campagne de la "Calypso" au large des côtes de l'Amérique du Sud. Annls. Inst. Océanogr., Paris 46: 33–59.

———. 1974. Ascidies littorales et bathyales récoltées au cours de la campagne Biaçores: Phlébobranches et Stolidobranches. Bull. Mus. Natl. Hist. Nat., Paris 3 ème Sér. 251 (Zool. 173): 1287–1325.

———. 1983. Ascidies littorales de Guadeloupe IV. Pyuzidae et Molgulidae. Bull. Mus. Natl. Hist. Nat., Paris 4 ème Sér. 5A(4): 1021–1044.

———. 1987. Ascidies de Nouvelle-Calédonie II. Les genres *Polycarpa* et *Polyandrocarpa*. Bull. Mus. Natl. Hist. Nat., Paris 4 ème Sér. 9A(2): 275–310.

——— and G. Bitar. 1983. Sur la présence de *Pyura stolonifera* (Tunicata Ascidiacea) à Ras Achaccar (côte nord atlantique marocaine). Comparaison anatomique distinctive avec *Pyura praeputialis*. Bull. Inst. Sci. Rabat 7: 83–91.

——— and F. Monniot. 1968. Tuniciers benthiques. *In* Campagne de la "Calypso" aux îles du Cap Vert (1959). Annls. Inst. Océanogr., Paris 45(2): 1–18.

——— and ———. 1976. Ascidies de la côte du Mozambique. Rev. Zool. Af. 90(2): 357–392.

——— and ———. 1983. Ascidies des fonds meubles situés autour de l'île de Port-Cros. Trav. Sci. Parc Natl. Port-Cros 9: 97–105.

——— and ———. 1984. Ascidies littorales de Guadeloupe VII. Espèces nouvelles et complémentaires à l'inventaire. Bull. Mus. Natl. Hist. Nat., Paris 4 ème Sér. 6A(3): 567–582.

———, ——— and K. D. Leung Tack. 1987. Une nouvelle espèce d'ascidie du Sénégal: *Polycarpa longitubis* n. sp. (Styelidae). Bull. Inst. Fondam. Af. Noire (A), 45(3–4): 308–315.

——— and ———. 1987. Les ascidies de Polynésie française. Mem. Mus. Natl. Hist. Nat., Paris Zool. 136: 1–155.

Monniot, F. 1969. Sur une collection d'ascidies composées de Dakar. Bull. Mus. Natl. Hist. Nat., Paris 2 ème Sér. 41(2): 426–447.

———. 1974. Ascidies littorales et bathyales récoltées au cours de la campagne Biaçores: Aplousobranches. Bull. Mus. Natl. Hist. Nat., Paris 3 ème Sér. 251 (Zool. 173): 1287–1325.

———. 1983. Ascidies littorales de Guadeloupe I. Didemnidae. Bull. Mus. Natl. Hist. Nat., Paris 4 ème Sér. 5A(1): 5–49.

Nishikawa, T. 1991. The ascidians of the Japan Sea. II. Publ. Seto Mar. Biol. Lab. 35(1–3): 25–170.

Pérès, J. M. 1948. Sur une collection d'ascidies de la zone intercotidale de Dakar. Bull. Mus. Natl. Hist. Nat., Paris 2 ème Sér. 20(1): 87–95.

———. 1949. Contribution à l'étude des ascidies de la côte occidentale d'Afrique. Bull. Inst. Fr. Af. Noire 11: 159–209.

———. 1951. Nouvelle contribution à l'étude des ascidies de la côte occidentale d'Afrique. Bull. Inst. Fr. Af. Noire. 13: 1051–1071.

———. 1957. Ascidies récoltées dans les parages des Baléares par le "Professeur Lacaze-Duthiers" (deuxième partie: Iviza et San Antonio). Vie Millieu Suppl. 6: 223–234.

Ramos, A. A. 1988. Ascidias littorales del Mediterraneo iberico. Faunistica, ecologia y biogeografia. Thesis, Universidad de Barcelona. 440 pp.

Rennie, J. and H. Wiseman. 1906. On collections of the Cape Verde Island marine fauna, made by Cyril Crossland of St. Andrew University, July to September 1904. Proc. Zool. Soc. London 1906: 903–911.

Rodrigues, S. A. 1977. Notes on Brazilian ascidians II. On the records of *Polyandrocarpa anguinea* (Sluiter) and *P. maxima* (Sluiter). Rev. Brazil. Biol. 37(4): 721–726.

Roule, L. 1884. Sur deux nouvelles espèces d'ascidies simples (famille des Phallusiadées). C. R. Acad. Sci., Paris 99: 243–246.

Sluiter, C. P. 1898a. Beiträge zur Kenntnis der Fauna von Südafrica Ergebnisse einer Reise von Prof. Max Weber in Jahre 1894 II. Tunicaten von Süd Africa. Zool. Jb. Syst. 11: 1–64.

———. 1898b. Tuniciers recueillis en 1896 par la "Chazalie" dans la Mer des Antilles. Mém. Soc. Zool. Fr. 11: 5–34.

———. 1904. Die Tunicaten der "Siboga"-Expedition Pt. I. Die socialen und holosomen Ascidien. "Siboga" Exped. 56A: 1–139.

———. 1915. Einige neue Ascidien von der West-Kuste Africas. Tijdschr. Neder. Dierk. Ver. 14: 37–57.

———. 1927. Les ascidies de la côte atlantique du Maroc. Bull. Soc. Sci. Maroc 7: 50–99.

Tokioka, T. 1953. Ascidians of Sagami Bay. Tokyo, Iwanami Shoten. 313 pp.

———. 1961. Ascidians collected during the Melanesia expedition of the Osaka Museum of Natural History I. Ascidians presented by Dr. R. L. A. Catala of the Aquarium of Nouméa. Publ. Seto Mar. Biol. Lab. 9(1): 103–138.

Turon, X. 1987. Estudio morfologico de las espinulas sifonales en las especies del genero *Microcosmus* (Ascidiacea) del litoral mediterraneo espanol. Anales Biol. 11 (Biol. Anim. 3): 37–42.

Van Name, W. G. 1918. Ascidians from the Philippines and adjacent waters. Bull. U.S. Natn. Mus. 100(1): 49–174.

———. 1921. Ascidians of the West Indian region and south eastern United States. Bull. Amer. Mus. Nat. Hist. 44: 283–494.

———. 1930. The ascidians of Puerto Rico and the Virgin Islands. Sci. Surv. Puerto Rico and Virgin Ils. New York Acad. Sci. 10: 401–512.

Vasseur, P. 1967. Contribution à l'étude des ascidies de l'île Maurice (Archipel des Mascareignes, Océan Indien). Rec. Trav. Stn. Mar. Endoume Suppl. 6: 101–139.

DATE ACCEPTED: November 10, 1992.

ADDRESS: *Biologie des Invertébrés marins et Malacologie, Muséum National d'Histoire Naturelle, UA 699, CNRS, 55 rue Buffon, 75005 Paris, France.*